



Blue Mussel Adhesives: Scientists clone nature's strongest adhesive proteins

Technology from Mother Nature is often hard to beat, so Idaho National Laboratory scientists genetically analyzed the adhesive proteins produced by blue mussels, a seafood delicacy. After obtaining full-length DNA sequences encoding these proteins, reproducing Mother Nature's adhesives will revolutionize commercial production and use of adhesives.

Blue mussel adhesives are stronger, non-toxic, biocompatible and more suitable for a variety of uses than any commercially available adhesives for aqueous applications on the market. Mussels secrete nine different protein components that can be produced using recombinant DNA techniques.

"It takes 10,000 blue mussels using the protein extraction method to make a gram of adhesive. This is not feasible nor affordable for the amount of adhesives required in today's world," said INL scientist Frank Roberto.

"Our breakthrough enables us to produce a superior, naturally-occurring adhesive to replace toxic, expensive and environmentally harmful adhesives synthesized from petroleum," said INL scientist Heather Silverman. "With our discovery, we can meet the challenge of obtaining reliable, pure, large-scale supplies of natural mussel adhesive proteins. We are very pleased and excited about this contribution."

The superior recombinant adhesive proteins have key advantages. They can:

- Replicate natural materials;
- Exist as environmentally friendly and non-toxic substances;
- Adhere under water and set up in 60 seconds;
- Bond to many substances (glass to concrete to wood);
- Maintain strength and durability over time; and
- Offer large-scale production at a low cost.

"The applications for stronger and more robust adhesives in the modern world are growing rapidly," said Roberto. "The ability to mass produce the natural adhesive proteins from a marine mollusk you see attached here allow us to provide materials for use in key applications such as:

- Marine and military operations, construction and repair;
- Construction materials and repair;

- Electronics, such as adhesives for hard disk metal substrates;
- Biomedical for surgery, emergency wound closure, cardiology grafts and implant repair, dentistry, corneal implants, orthopedics and much more.”

“Our discovery opens a new, direct route to large-scale production of these proteins through genetic engineering and recombinant DNA techniques,” said Silverman. “Low-value crops such as tobacco or potatoes can be used to produce blue mussel proteins in commercial quantities, competitively priced and in an environmentally-friendly way.”

For the first time, Mother Nature’s adhesive secrets can be used on a wide scale to safely and affordably improve health, work and quality of life.